DESCRIPTION

Plastic Bottles

TECHNICAL FIELD

This invention relates to plastic bottles to be used as liquid containers, more specifically to plastic bottles for beverages which are to be hot-filled or aseptic-filled.

BACKGROUND ART

Biaxially stretched blow-molded bottles made from polyethylene terephthalate (PET) are widely used as beverage containers. Containers are usually filled with beverage product either by hot-filling or by aseptic-filling. In hot-filling, biaxially stretched blow-molded containers are filled with beverage which has been heated to around 90°C, sealed with a cap, and are then cooled. In aseptic-filling, containers are sterilized, and are then filled in the resultant aseptic environment. Hot-filling has been accompanied with a problem that containers expand when filled or capped, and that, when cooled, containers shrink due to reduced pressure inside. Also aseptic-filling has had a problem that containers shrink due to reduced pressure which is caused by the contents' absorbing oxygen in the head space.

In recent years, these PET bottles are often displayed in a warmed showcase. This causes a problem that containers swell due to increased internal pressure when warmed.

As a solution to the above-mentioned problems, bottles are usually provided, on their body, with an absorption panel or concave ribs which swell when the bottle expands and shrink when the bottle is decompressed, and thus absorb deformation. In another

solution, the amount of material resin is increased by which to enhance the rigidity of bottles. These approaches require a large absorption panel, which compromises the appearance of bottle. Also from the viewpoint of overall design, these bottles lack continuity in outline, and therefore look awkward.

In addition, absorption panels have a concave-convex shape. Hence, when shrink-label is put on bottle for surface decoration, gaps can be made between the bottle and the shrink-label to cause a problem that bottle becomes difficult to handle, that shrink-label is torn during transportation, and that moisture which has been trapped in these gaps is difficult to be removed.

If no heat insulation panel is used so that the bottle may have a cylindrical shape by which to avoid the above-mentioned problems, bottles shrink unevenly when decompressed, compromising their appearance. Besides, if the amount of material resin of bottle is reduced, longitudinal buckling strength is decreased, and, therefore, bottles crush when stacked. Due to these problems, the only realistic way to make bottles withstand decompression has been to increase the amount of material resin of bottle, which is undesirable from the viewpoint of productivity and economy.

Another possible solution is a polygonal bottle as shown in Japanese Design Registration No. 935840. This solution has a problem that bottles of this shape has low strength due to the lack of heat insulation panel. Hence, each face which constitutes side wall is deflected in vertical direction under reduced pressure, resulting in conspicuous deformation. Otherwise, portions with a small wall-thickness give way under reduced pressure, and, thus, only the faces of those portions are buckled to

exhibit remarkable deformation.

In the bottles as shown in Japanese Design Registration No. 961967, triangular faces are arranged geometrically and on upper and lower parts of twisted wall, which structure serves to give strong bottles. Besides, vertical section (side wall) has a terraced shape with a recession, which also contributes to strength. Each of the twisted side faces resists deformation as a result of the above-mentioned structure, which also serves to strengthen the bottle. Hence, the shape of bottle as disclosed in Japanese Design Registration No. 961967 is appropriately designed to increase bottle strength (enhance the rigidity of container). When reduced pressure is applied to bottle, however, high rigidity may give rise to buckling in thin areas alone, which leads to severe deformation. Furthermore, since vertical section has a terraced shape where triangular faces are complicatedly arranged, there is a concern that, in an sterilization step of aseptic filling, the flow of sterilizing liquid may be insufficient in some areas, or that the liquid may be incompletely rinsed away.

Moreover, the shape of bottles has so far been restricted to stereotype such as cylindrical or square to ensure fast and reliable feeding of bottles on beverage production lines, and especially to ensure that bottles do not tumble down when slid and fed on continuous production lines, and also to make it easy to pack bottles neatly in casers.

DISCLOSURE OF INVENTION

In order to resolve the above-mentioned problems with conventional bottles, this invention is to provide, at a low price, plastic beverage bottles which, in aseptic-filling and hot-filling, are not deformed

awkwardly by the change in internal pressure which is caused by warming or cooling, are capable of absorbing decompressed volume, are so well-designed as to avoid poor appearance, and are easy for consumers to handle, free from tearing or peeling of shrink-labels during transportation, have high load capacity strength and horizontal compression strength as well as package strength, and bring no problem in bottle-filling line.

To satisfy the above-mentioned objective, the plastic bottles of this invention are characterized in that: they are composed of neck, shoulder, body and bottom; the cross-sectional shape at the body is a regular polygon, whose angles have an even number of not less than 4 nor more than 32; each angle of the polygon is rounded off by an arc whose radius is not longer than half the radius of a circle circumscribed about the cross-sectional shape at body; cross-sectional shapes are the same at any portion of body; circles circumscribed about the cross-sectional shapes are identical with one another; the circumscribed circles have a center on the vertical central axis of body; and the cross-sectional shape of body rotates around said central axis in proportion to height along said central axis.

In a preferred embodiment of the above-mentioned plastic bottles, the cross-section of body rotates to make a rotation angle of 360°/the number of angles in the polygon.

In another preferred embodiment of the above-mentioned plastic bottles, cross-section at shoulder is also a polygon wherein each angle thereof is rounded off by a circular arc, and said cross-section does not rotate.

In another preferred embodiment of the above-mentioned plastic bottles, the plastic bottle is made

from polyethylene terephthalate, and is molded by biaxial stretch blow molding.

A bottle which has been manufactured under these conditions has a wall-side of a shape of twisted regular polyhedron from bottom to shoulder. When this container is decompressed, each face is decompressed while the container as a whole neutralizes deformation caused by the decompression, in the direction of the twist. Thus, although deformation takes place, it is not conspicuous as compared with the shape of container before deformation. With regard to strength of resistance to decompression induced by deformation, the bottle deforms as a whole so that deformation may be neutralized, and, therefore, remarkable deformation such as so-called buckling is hard to occur. Thus, the bottle of this invention can be said to be stronger against decompression than conventional bottles, in view of the concept of "remarkable deformation which affects the acceptability of products". It may be said that the bottle of this invention breathes in accordance with change in internal pressure. It has been confirmed that, on the afore-mentioned accounts, even though severe deformation like buckling occurs, the bottle returns to the original shape as soon as decompression is eased, unlike conventional bottles reinforced with panels that do not return to their original shapes.

This invention provides plastic beverage bottles which, in aseptic-filling and hot-filling, are not deformed awkwardly by the change in internal pressure which is caused by warming or cooling, are so well-designed as to avoid poor appearance, and are easy for consumers to handle, free from peeling of shrink-labels during transportation, have high load capacity strength, and bring no problem in bottle-filling line.

In conventional plastic bottles, when internal pressure changes, central axis of neck section leans out of the central axis of body of the bottle, and, thus, deformation occurs. In the bottle of this invention, plural numbers of helixes are wound tighter around the body, with the result that the height of plastic bottle decreases, and, accordingly, volume is decreased. Or, on the contrary, plural numbers of helixes are wound more loosely, with the result that the height of plastic increases, and, accordingly, volume is increased. Such deformation prevents the plastic bottle of this invention from deforming in such a way that the central axis of its neck section leans out of central axis of body section.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1:
Schematic drawing of an embodiment of this invention
Figure 2:
Cross-section of the body of bottle of an embodiment of the invention
Figure 3:
Cross-section of the body of bottle of an embodiment of the invention

BEST MODE FOR CARRYING OUT THE INVENTION

Figure 1 illustrates an embodiment of this invention. The plastic bottle (1) of this invention is comprised of neck (2), shoulder (3), body (4), and bottom (5), and the bottle (1) is to be sealed with a closure (6). As closure (6), anything can be acceptable so long as it ensures a secure seal. Examples of closures include screw caps, push caps, and heat-sealing, among which screw cap is preferable in view of re-capping after opened.

As the material of plastic bottle, polypropylene, polyethylene, polyamide, polyethylene terephthalate, and laminate thereof are thinkable. Anything of these is allowable so long as it is capable of forming a desired bottle shape. In view of use for beverage, biaxially stretched blow-molded bottles made from polyethylene terephthalate are preferable.

Cross section (7) at the body of this plastic bottle (1) is regular polygon, wherein each angle is rounded off by arc (8). Any section has the same shape between the lower end (9) and the top end (10) of the body of plastic bottle. Owing to this feature, no concave is made on the body. Hence, when shrink label is placed as a surface decoration, there is made no gap between the bottle and the label, and, thus, label is prevented from peeled or torn during distribution, and, moreover, water is prevented from collecting between the bottle and the label. The absence of gap between the shrink label and the bottle gives consumers a better handling.

The bottle of this invention is further characterized in that any circle (11) circumscribed about the cross-section at the body has the same shape, and that the centers (12) of such circumscribed circles are placed on the same axis.

The number of angles of the regular polygon is preferably an even number between four and 32. If the number of angles is more than 32, the external shape becomes indistinguishable from that of a cylindrical bottle. Six or eight is desirable from the viewpoint of designing. If the number of angles is odd, wall thickness becomes non-uniform when bottle is blown-up. Furthermore, split line of blow-mold may become complicated, and scratch may occur when bottle is taken out of the mold.

Each angle of the polygon at body is rounded off by a circular arc (8) whose radius is not longer than half the radius of a circle (11) circumscribed about the cross-section of the body. This feature not only leads to excellent design, serving to give a beautiful expression of polygonal surfaces, but also produces ribbing effects when the radius of arc (8) is small, which effects enhance resistance to vertical loading.

Any section has the same shape between the lower end (9) and the top end (10) of the body of plastic bottle. Furthermore, any circle (11) circumscribed about the cross-section at the body has the same shape, and the centers (12) of such circumscribed circles are placed on the same axis. Owing to these features, bottles are less likely to become jammed on the production line.

Cross-section at the body is rotated around the center (12) of circle circumscribed about the cross-section at the body, and in proportion to height. This feature achieves flowing outline together with improved resistance to horizontal load. Due to this rotation, contact surfaces of bottle come near to circular shape, which improves rolling property. This also makes it easy to charge a vending machine with bottles.

Also with regard to change in internal volume which has been a technical problem, bottles are expanded or contracted in vertical direction owing to rotation, and are thus allowed to deform without damaging appearance. As for the relation between angle of the rotation of cross-sectional shape at body and height, it is preferably 0.6°/mm or less, or, more desirably, 360°/number of angles. When rotation angle is too large in relation to height, the undercut of mold becomes large, which causes a problem that it becomes difficult to draw bottles from the mold in blow molding, and that scratches occur when bottles are

drawn from mold. When the rotation angle is 360°/number of angles, there occurs no problem of undercut, and bottles are molded without any problem.

With respect to bottle design, also cross-sectional shape at shoulder may be a polygon whose angles are each rounded off by an arc, for the purpose of emphasizing the streamline image much more. In that case, it is preferable not to rotate the cross-sectional shape so as to avoid undercut problem.

EXAMPLE

An embodiment of the above-mentioned invention is explained by a working example as follows.

A bottle was manufactured by biaxial stretching blow-molding with use of polyethylene terephthalate. Material resin was used in an amount of 29 g, capacity was 500 ml, maximum diameter was 67 mm, and height was 207 mm. The bottle was composed of neck, shoulder, body and bottom. The cross-sectional shape at the body was a regular hexagon. Each angle of the regular hexagon was rounded off with an arc. Cross-sections had the same shape at any portion of body. Circles circumscribed about the crosssectional shape were identical. The centers of the circumscribed circles were on the same axis. The circumscribed circle had a radius of 33.5 mm. The arc had a radius of 5 mm.

Crosssectional shape at body was rotated uniformly at a rate of 0.4°/mm around the center, as axis, of circles circumscribed about said crosssectional shape. Total rotation angle was 60 degrees. Also at shoulder, crosssectional shape was a regular hexagon, where each angle was rounded off with an arc. The crosssectional shape was not rotated.

The bottles as designed above had good

acceptability, and had good "handleability" as well. After hot-pack filled and then cooled, the bottles caused no problem in production-line suitability. The bottles maintained acceptable appearance. When subjected to a transportation test, the bottles caused neither peeling of labels, nor buckling under loading.

INDUSTRIAL APPLICABILITY

The plastic bottles of this invention are usable as containers for beverages on the market.